THE MOUNTED SKELETONS OF CAMPTOSAURUS IN THE UNITED STATES NATIONAL MUSEUM.

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INTRODUCTION.

Recently the exhibition collection of vertebrate paleontology in the United States National Museum has been enriched by the addition of two mounted dinosaur skeletons from the Morrison Beds of Wyoming. These specimens are unusually perfect as fossil skeletons, and are noteworthy as being the types of the two species *Camptosaurus nanus* Marsh (Cat. No. 2210, U.S.N.M.) and *Camptosaurus browni* Gilmore (Cat. No. 4282, U.S.N.M.). Since a detailed description of the osteological features of these specimens has been given in a previous article,[1] the present paper will briefly describe the mounted skeletons.

These specimens formed a part of the Marsh collection that was transferred to the Museum some years ago by the United States Geological Survey, and are from one of the celebrated fossil deposits of the Morrison beds, known to the collectors as "Quarry 13," located about 8 miles east of "Como Bluff," Albany County, Wyoming.

The skeletons are typical examples of the large and small species of the genus, and as they are mounted upon the same base, show well the great difference in size. (See pls. 56 and 57.) They are standing on a base of artificial matrix that represents the color and texture of the layer of sandstone in which the bones were found.

The larger skeleton (*C. browni*) is mounted in a quadrupedal posture, an attitude which it is believed was often assumed, and the smaller specimen (*C. nanus*) has been erected in the more familiar pose of walking on the hind limbs.

The skeleton of *Camptosaurus browni* was mounted by the writer, while the skeleton of *C. nanus* was erected by Mr. Norman Boss, preparator in the section of vertebrate paleontology, and to his skill is due the workmanlike manner of the finish and its life-like pose.

[1] C. W. Gilmore. Osteology of the Jurassic Reptile Camptosaurus, with a revision of the Species of the Genus, and Description of two new species. Proc. U. S. Nat. Mus., vol. 36, 1909, pp. 197–333, pls. 6–20.

SKELETON OF CAMPTOSAURUS BROWNI.

Although Prof. O. C. Marsh made the first pictorial[1] restoration of *Camptosaurus dispar* as early as 1894 the United States National Museum has the distinction of being the first to erect in a life-like posture the actual skeleton of one of the large species of *Camptosaurus*, and while Marsh's earlier restoration gave a good general idea of the appearance of the animal, it is now known, as has been pointed out previously, to have been in error in several particulars.

The most striking of the changes brought about by the study and reconstruction of these specimens is the shortening of the presacral region. In the first restoration (Marsh's) there are 30 presacral vertebræ, 9 of which belong to the cervical region, thus leaving 21 thoracic vertebræ. The two skeletons considered here agree in having 16 dorsals each, and accepting this as the correct number, the series has been shortened by 5 vertebræ, making the proportions quite different from the first conception. It lessens perceptibly the space between the fore and hind limbs, producing a more compact and better balanced animal.

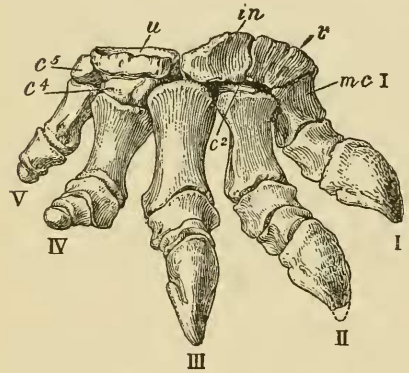

FIG. 1.—RIGHT FORE FOOT, CAMPTOSAURUS DISPAR MARSH, CAT. NO. 4277, U.S.N.M.; ¼ NAT. SIZE. SEEN FROM THE FRONT. c^2, CARPAL TWO; c^4, CARPAL 4; c^5, CARPAL FIVE; *in*, INTERMEDIUM; *mc I*, METACARPAL I; *r*, RADIALE; *u*, ULNARE; I TO V, DIGITS ONE TO FIVE. UNGUAL OF FIRST DIGIT RESTORED.

It is also shown by these specimens that all of the vertebræ preceding the sacrum carried ribs, and therefore there are no true lumbar vertebræ.

Other features which can best be appreciated in the mounted skeleton are the small head, curved neck, short and widely expanded body cavity, long tail, and the great disparity in size between the fore and hind limbs.

The great strength of the hind legs is at once evident from the size of the femora, tibiæ, and feet. (See fig. 4.) The enormous development of the fourth trochanter on the femur indicates a powerful caudo-femoral muscle. That the animal usually walked with an upright, bipedal gait, as amplified by the small skeleton, seems apparent, although certain characters of the fore feet appear to indicate a considerable use in locomotion.

The compact ossified carpus, with smooth, well-defined, articulating surfaces, short and stout metacarpals, all are indicative of a foot

[1] Amer. Journ. Sci., vol. 47, Mar., 1894, pl. 6.

whose function was that of support rather than of a grasping or prehensile organ.

As stated previously, while the writer believes that the upright bipedal posture was frequently assumed, it does appear from the facts mentioned above that *Camptosaurus* used the quadrupedal mode of progression more frequently than any other known member of the Ornithopoda, and in this genus it may represent the beginning of the development of a fore foot where quadrupedalism was to become a fixed means of locomotion as it has in *Stegosaurus* and in the Ceratopsia.

The stiff divergent pollex, brought about by the ankylosis of the first metacarpal (which is much shortened) with the radiale, is an interesting feature of the fore foot. In this respect there seems to be a trend toward the development of a "spikelike" digit as found in the fore foot of the *Iguanodon* of Europe. (Compare figs. 1 and 2.) The skull has been modeled after a careful study of all known cranial material, and it is believed to be the most correct restoration yet produced, although future discoveries will probably show the present conception to be in error in some particulars.

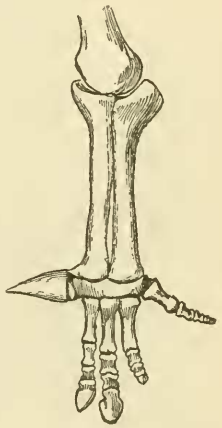

FIG. 2.—LEFT FORE FOOT OF IGUANODON. I, FIRST DIGIT OR POLLEX.

In *Camptosaurus* the dentition is confined to the rear portions of the jaws, the anterior part of the mouth being toothless and probably sheathed in a horny beak which served for cropping off the bushes or herbage on which these animals fed. The teeth are of moderate size with sculptured margins (see fig. 3), implying a food of rather yielding character which did not require forcible mastication.

These skeletons represent the animals as touching nearly the whole length of the toes (excepting the first) to the ground. They were so mounted because of the fact that all the three-toed supposed dinosaurian footprints show the imprint of nearly the full length of the phalanges.

The pathological condition of the right ilium of *C. browni* is of interest in showing to what extent the shape of a bone may be modified by external injury (see pl. 58). On the posterior half, the comparatively thin, platelike part of the ilium is divided vertically, the two halves swelling out to form the walls of a cavity which extends downward, emerging on the ventral border. The cavity is longer than wide, measuring on the upper border of the opening 86 mm. in a longitudinal direction and 46 mm. in the transverse, the ventral exit being

considerably smaller. As indicated by a deep depression on the dorsal border, the injury was probably received from above.

The exostosis of the bone was greatest on the front side of the cavity where it measures 72 mm. in width. The normal width of this part of the ilium, as shown by one on the opposite side, is only 21 mm. A second injury was found on one of the caudal vertebræ near the root of the tail, as indicated by the pathological condition of the spinous process, which is considerably enlarged and has near its base an elongated opening which perforates the bone. While the wound in the ilium must have been an exceedingly painful one at the time of infliction, it in no way utterly disabled the animal, at least to the extent of leading to its death, as all of the broken margins of the bone had healed. Although these injuries may have been inflicted by some of its large carnivorous contemporaries, the position

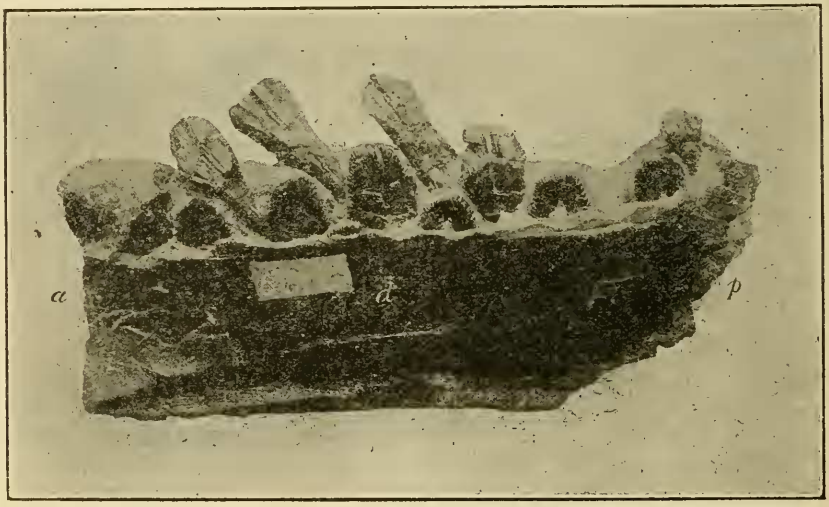

FIG. 3.—RIGHT DENTARY OF CAMPTOSAURUS. INTERNAL VIEW SHOWING DENTITION OF LOWER JAW. ABOUT $\frac{2}{3}$ NAT. SIZE. *a*, ANTERIOR END; *d*, DENTARY; *p*, POSTERIOR END.

of the wounds suggests the idea that this individual was a female who might have received the injuries during copulation.

The evolutionary history of *Camptosaurus* is largely unknown. The nearest allied form appears to be *Iguanodon*, found in Europe, and Prof. O. C. Marsh was among the first to recognize the many similarities in structure between *Camptosaurus* and *Iguanodon*. While the former is proportionally much lighter and more delicately constructed, the habits and mode of life of the two animals must have been very similar. In many particulars, however, *Camptosaurus* represents a more generalized type, as is shown by the somewhat simpler structure of the teeth, the less reduced pollex and hallux, the postpubis reaching to the end of the ischium, and the more proximal position of the fourth trochanter of the femur.

Amount of restoration.—The drawing, plate 58, shows plainly all of the restored parts. The bones supplied from other individuals are listed below.

No. 4277. Right hind foot, excepting ungual of digit IV.
No. 4697. Left hind foot.
No. 5959. Right femur, tibia, astragulus, and fibula.
No. 5961. Left fibula and calcaneum.
No. 6001. Fifth cervical vertebra.
No. 6016. Left femur.
No. 7076. Left tibia.

All of the bones introduced are from individuals found in the same quarry ("13") as the type-specimen. Those bearing the catalogue numbers 4277, 4697, and 5959 have been identified as belonging to the species *Camptosaurus dispar* Marsh. It was at first intended to replace these missing parts with restored bones, but since they must necessarily be copies of these bones, it was finally decided to use the originals even though they do pertain to another species. In this connection it is reasonable to suppose that when the hind limbs of *C. browni* are known, they will be found to differ but little from those bones introduced.

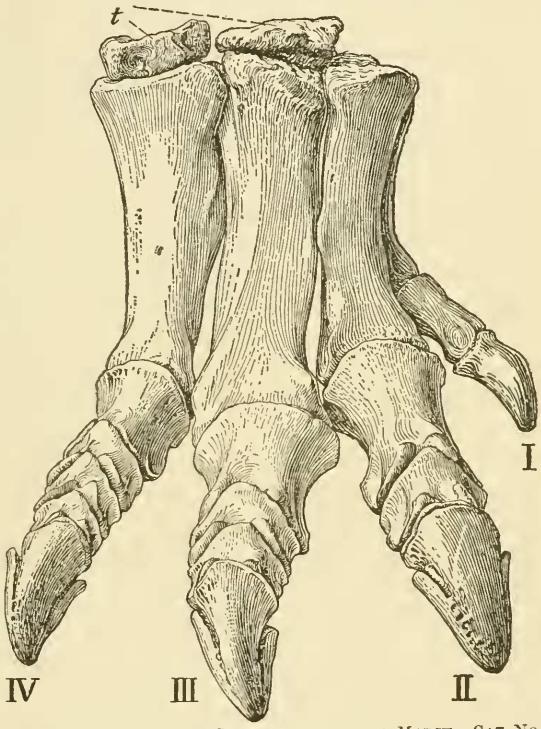

FIG. 4.—RIGHT HIND FOOT, CAMPTOSAURUS DISPAR MARSH. CAT. NO. 4277, U.S.N.M.; ¼ NAT. SIZE. SEEN FROM THE FRONT: *t*, TWO TARSAL BONES OF THE DISTAL ROW; *I, II, III, IV*, FIRST TO FOURTH DIGITS. UNGUALS OF DIGITS *I, III*, AND *IV* DRAWN FROM THE FEET OF OTHER INDIVIDUALS.

To make the record of this skeleton complete, diagrams 5 and 7 of quarry 13 and an account of the way in which the bones were found in the ground are here appended.

The accompanying map (see pl. 55) shows how the bones of *Camptosaurus browni* were found as they lay embedded in the ground. The map was drawn at the time of disinterment, and the painstaking care bestowed on it is worthy of the highest commendation. A quarter of a century has elapsed since this skeleton was collected.

During the interval the material from this area had become widely scattered, but by the aid of the map the specimens were not only assembled, but it was possible to again place all of the elements in their original relative positions.

Most of the skeleton lay in diagram 5, but a study of the contiguous area represented by diagram 7 showed other elements which could, beyond a reasonable doubt, be associated with the same individual, although collected a year later. The main axis of the skeleton lay in a northeast and southwest direction, and apparently not far removed from where the animal died.

As indicated by the original quarry numbers, the left fore limb and foot and anterior dorsal vertebræ were the first elements discovered. The limb and foot bones lay on the left side of the vertebral column in the positions indicated on the map (see Nos. 83, 84, and 85), the scapula and coracoid being removed some 5 feet to the left of the lower limb bones, but inasmuch as this is the only skeleton of *Camptosaurus* found in this part of the quarry, and as it pertains to the left side, there can be no doubt of their proper association. The vertebral column, which appears quite complete, was disarticulated at intervals. Beginning with the anterior portion of the backbone as preserved, cervicals 78, 77, and 76 were articulated by their zygapophyses and represent, respectively, the eighth and ninth cervicals and first dorsal. No. 83, although not interlocked with 78, was but little removed from it, and appears without question to represent the seventh cervical. Two other cervicals, No. 109 and another from which the original quarry number has been erased, are also provisionally associated with this skeleton, and represent the fourth and third cervicals, respectively. On account of the erasure of the quarry number the position of the third cervical could not be found on the map, although it was associated with the bones of this skeleton. The vertebræ of the next series, Nos. 101 to 106, while not interlocked by their zygapophyses, were so closely associated that there can be no question of their representing a series, and when articulated fit one another perfectly. The position of the capitular facets and shape of the spinous processes show them to pertain to the anterior dorsal region. An interval of a foot or more existed between No. 106 of this series and No. 76. In the next series, Nos. 120 to 136, the vertebræ were found occupying their relative positions and but little disturbed. From the adhering matrix the writer was able to connect up this series from the middorsal through the sacrals to the fourth caudal, inclusive. Caudals Nos. 168 to 169 and Nos. 158 and 159 were removed somewhat laterally, but were intermediate in size and appear to fill the gap between 136 and 170. Nos. 170 to 174, with their chevrons, were found articulated. Another series of four vertebræ (block 208) was

shown in diagram 7, some 14 feet to the east of No. 174; but an anterior zygapophysis, retained in place by the matrix of the latter, was found to fit on the first vertebra of this series, and so fixed beyond doubt their proper position in the tail. Some 14 or 15 feet to the north and east another series of 18 distal caudals (Nos. 218 to 235) was found, most of them articulated or so closely associated that it appears none are missing in the series.

It is perhaps fortunate that while the other bones in this area represent the remains of several individuals, nearly all pertain to the genus *Stegosaurus*, from which the elements of *Camptosaurus* are readily distinguishable. This remark applies particularly to the rounded distal caudals of *Camptosaurus*, which may at once be distinguished from the short hexagonal caudal centra of *Stegosaurus*. That this distal series belongs to *C. browni* there can be but little question. The ilia, Nos. 140 and 167, lay on their respective sides of the sacrum and but little removed from it, with their anterior ends directed forward. The other pelvic bones were not indicated on the map, but from their quarry numbers it was determined they could not have been far removed. Nothing of the hind limbs was found. The right fore limb (and foot) Nos. 98, 101, 119, and 120, were found to the west and right of the anterior cervicals. From the fact that all of the elements pertain to a right limb and closely agree in size with the left, its assignment appears certain. Some scattered ribs and pieces found near the dorsals have been provisionally associated with them. All of the remaining material from diagrams 5 and 7 has been gone over carefully in the hope of finding some elements of the skull and other missing parts, but without reward. It appears remarkable that in a skeleton which shows so little displacement of the elements as this one that the heavy bones of the hind limbs should be missing. An unusual feature is the preservation of both fore limbs and feet. Experience of several seasons' field work has shown that while it is not unusual to find hind limbs fairly complete, the front legs, particularly of the Jurassic sauropods, are rare.

By reference to the quarry map (see pl. 55), all of the evidence as to the association of the parts may be plainly seen. The bones not numbered pertain to one or more genera different from *Camptosaurus*. The series to the east of the vertebral column represents a caudal series of *Stegosaurus*, and most of the other scattered elements have been recognized as belonging to that genus. With the exception of two caudal vertebræ, no duplicate bones of *Camptosaurus* have been found. There can be therefore little question but that all of the elements indicated as *Camptosaurus* belong to one individual.

The position of the bones of the skeleton, as found in the quarry, is shown in diagrams 5 and 7, plate 55. The position of the different parts is indicated by the original quarry numbers as follows:

IN DIAGRAM 5.

80. Chevron, 15th.
81. Dorsal rib.
83. Fifth dorsal rib of the right side.
84. Left humerus.
85. Left radius, ulna, and manus.
98. Spinous process.
101 to 106. Dorsals (2, 3, 4, 5, 6, and 7 of series).
106. Eighth thoracic rib of the right side.
107. Head of dorsal rib.
109. Piece of dorsal rib.
113. Portion of right ischium.
115. Left ischium.
116. Dorsal rib (portion of head).
120 to 128. Dorsals (8th to 16th of series).
129 to 133. Sacrals.
134 to 136. Caudals (1, 2, and 3 of series).
140. Left ilium.
157. Portion of dorsal rib.
158. Caudal (6th of series).
159. Caudal (5th of series).
167. Right ilium.
168. Caudal (3d of series).
169. Caudal (4th of series).
170 to 174. Caudals (7, 8, 9, 10, 11, and 12 of series).
175, 176. Caudal vertebræ.
178. Chevron.
—— Portion of right pubis.
—— Part of left pubis.

IN DIAGRAM 7.

45. Left scapula.
46. Left coracoid.
76. First dorsal.
77. Ninth cervical with one rib.
78. Eighth cervical with both ribs.
83. Seventh cervical.
84. Right humerus.
98. Right coracoid.
101. Right scapula.
109. Fourth cervical.
119. Right radius and ulna.
120. Right manus.
177. Ungual of Digit IV, right hind foot.
208. Caudals (13, 14, 15, and 16 of series).
218 to 235. Caudals (22d to 38th of series).

Dimensions.—The entire length of the animal measured along the back bone is 17 feet; from the base to the top of the hip bones is 4 feet 6 inches in length. The tail measures 8 feet 6 inches in length.

SKELETON OF CAMPTOSAURUS NANUS.

The small skeleton shown in plates 59 and 60 was in 1894 briefly described [1] by Prof. O. C. Marsh as the type of a new species, and later a more detailed account [2] of this specimen was given by the writer.

The elements preserved are as follows:

Axis intercentrum, axis, 7 cervical, 16 dorsal, 4 sacral, and 34 caudal vertebræ, 1 cervical and numerous thoracic ribs, right forelimb (scapula, coracoid, humerus, radius, and ulna), 2 femora, 2 tibiæ, left fibula, 2 ilia, 2 ischia, portion of left pubis, 2 metacarpals, 1 carpal, and parts of ossified tendons.

The specimen was collected by Mr. W. H. Reed from "quarry 13" in 1882.

[1] O. C. Marsh. Amer Journ. Sci., ser. 3, vol. 48, 1894, p. 85 pl. 5, fig. 3.
[2] C. W. Gilmore. Proc. U. S. Nat. Mus., vol. 36, 1909, pp. 280–285.

The skeleton as mounted is composed of the bones of one individual with the exception of the second and third metatarsals of the left hind foot which are from another individual (Cat. No. 5960) of the same proportions, and from the same quarry as the type. The other missing parts have been restored and painted a light color to make these distinct from the fossil portions.

As shown in plates 57 and 59 the specimen has been given the bipedal pose, with the intention of conveying to the observer the impression of a rapidly walking animal. The head is thrown forward, the arms balancing the sway of the shoulders. The right hind leg is at the end of the forward stride and bears the greater part of the weight of the animal. The left foot is just about to be lifted preparatory to the forward step, while the tail is doubly curved and lifted slightly from the ground to balance the weight of the forward part of the animal.

The head is comparatively small, and carried on a gracefully curved neck of moderate length. The thoracic region, which has 16 dorsal vertebræ, is of good proportions, and as the articulated ribs show in the posterior view (see pl. 60), the back was broad with a widely expanded body cavity. The animal was supported by stout clawed limbs of which the hinder are much longer and stouter than the fore. In life this animal was evidently strong and agile in movement, and the structure of the feet, as in *C. browni*, appear to indicate a strictly land-living form.

Unlike several of the other predentate dinosaurs, there have been no dermal ossifications found, so we have no knowledge as to the character of the external covering. The line drawing (see pl. 61) shows clearly the restored and original parts of the skeleton.

The caudal series consists of 42 vertebræ, of which 31 are considered as carrying chevrons.

The ischia, as articulated in these two skeletons, only meet at their distal extremities. The writer is, however, inclined to the opinion that in life the borders of the lower part of their shafts were in contact, somewhat after the manner of the ischia in *Trachodon* and *Ceratosaurus*, but, probably owing to distortion, it was found impossible to so articulate them when mounting the specimens.

As with *Camptosaurus browni*, the skull, which is wholly restored, is modeled in the proper proportions after a study of all known cranial material, and undoubtedly gives an accurate idea of the cranium.

In order to place on record all of the evidence relating to the primary association of the backbone of this skeleton, a complete list of the articulated vertebræ as found is given below.

Axis free; 3d cervical to 2d dorsal articulated; 3d dorsal free; 4th to 8th dorsals articulated; 9th to 13th dorsals articulated; 14th dorsal

free; centrum of 15th dorsal detached, although the spinous process remained attached to the 16th; 16th dorsal and sacral vertebræ articulated; 1st caudal free; 2d to 21st caudals articulated; 22d to 25th caudals articulated; 26th caudal free; 27th to 29th caudals articulated; 30th and 31st caudals articulated; 35th caudal free.

Dimensions.—The entire length of the animal, measured along the backbone, is 9 feet 11 inches; from the base to the top of the hip bones, 1 foot 9 inches; from base to top of head, 2 feet 8½ inches; length of tail, 3 feet 6 inches.

EXPLANATION OF PLATES.

PLATE 55.

Diagrams 5, 7, and part of 4, of quarry 13, near Como, Albany County, Wyoming, worked by Mr. Fred Brown for Prof. O. C. Marsh, during the years 1884, 1885, and 1886. The numbered bones show the positions in which the various elements of the type of *Camptosaurus browni*, Cat. No. 4282, U.S.N.M., were found in the quarry. The unnumbered bones scattered about pertain chiefly to members of the Stegosauria.

A. Plesiotype of *Diracodon laticeps*, Cat. No. 4288, U.S.N.M.

B. Series of caudals and dermal plates of *Stegosaurus*, Cat. No. 4714, U.S.N.M.

The scale is about 4 feet to the inch.

PLATE 56.

Mounted skeletons of *Camptosaurus browni* Gilmore, Cat. No. 4282 U.S.N.M., and *C. nanus* Marsh, Cat. No. 2210, U.S.N.M.

Type-specimens. Oblique side view.

About one-twentieth natural size.

PLATE 57.

Mounted skeletons of *Camptosaurus browni* Gilmore and *C. nanus* Marsh. Type-specimens. Viewed from the left side.

About one-twentieth natural size.

PLATE 58.

Drawing of the skeleton of *Camptosaurus browni* showing the real and restored parts. Original bones are represented by line shading and parts restored are left in outline.

More than one-twentieth natural size.

PLATE 59.

Mounted skeleton of *Camptosaurus nanus* Marsh. Oblique view. Type-specimen.

About one-eighth natural size.

PLATE 60.

Rear view of *Camptosaurus nanus* Marsh. Showing the pose of the tail and expanded body cavity. Type-specimen.

PLATE 61.

Drawing of the skeleton of *Camptosaurus nanus* Marsh. Showing the real and restored parts. Original bones are represented by line shading and parts restored are left in outline.

More than one-eighth natural size.